DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1-9 and 11 are rejected under 35 U.S.C. 102(b) as being anticipated by Hohl et al. (J. Phys.: Condens. Matter, 10, 1998, pp. 7843-7850).

As to claim 1, the reference teaches a thermoelectric conversion material comprising:

- a half-Heusler alloy (half-filled Heusler, p. 7844, line 2) represented by the formula $QR(L_{1-p}Z_p)$, ($NbIrSn_{1-x}Sb_x$, 7845:28), where
- Q is at least one element selected from group 5 elements (Nb, 7845:28),
- R is at least one element selected from cobalt, rhodium, and iridium (Ir, 7845:28),
- L is at least one element selected from tin and germanium (Sn 7845:28),
- Z is at least one element selected from indium and antimony (Sb 7845:28), and
- p is a numerical value that is equal to or greater than 0 and less than 0.5 (p is 0.01 7845:28).

The examiner notes that when p=0, the chemical formula $QR(L_{1-p}Z_p)$ reduces to QRL. This corresponds to ABX of the reference, wherein Q (A, 7843:2-3), R (B, 7843:3-4) and L (X, 7843:4-5) are present in an atomic ratio of 1:1:1 (ABX, 7843:1).

Regarding claims 2-4, the reference teaches that p is 0.01 (x=0.01, 7845:28).

Regarding claim 5, the reference teaches that Q is niobium (Nb, 7845:28).

Regarding claim 6, the reference teaches that R is cobalt (A=Nb, 1st column, Table 2).

Regarding claim 7, the reference teaches that L is tin (Sn, 7845:28).

Regarding claim 8, the reference teaches that p is 0.01 (x=0.01, 7845:28) and Z is antimony (Sb 7845:28).

Regarding claim 9, the reference teaches that Q is niobium (A=Nb, Table 2), R is cobalt (B=Co, Table 2) and L is tin (X=Sn, Table 2 and 7844:3).

Regarding claim 11, the reference teaches that the half-Heusler alloy is made of single phase (7846:34-36).

3. Claims 1, 6, and 9 are rejected under 35 U.S.C. 102(b) as being anticipated by Tobola et al. (J. Phys.: Condens. Matter, 10, 1998, pp. 1013-1032, cited in Applicant's IDS).

As to claim 1 the reference teaches a thermoelectric conversion material comprising:

- a half-Heusler alloy (semi-Heusler compound, abstract) represented by the formula $QR(L_{1-p}Z_p)$, (NbCoSn, page 1023, line 14), where
- Q is at least one element selected from group 5 elements (Nb, 1023:14),
- R is at least one element selected from cobalt, rhodium, and iridium (Co, 1023:14),
- L is at least one element selected from tin and germanium (Sn, 1023:14), and
- p is a numerical value that is equal to or greater than 0 and less than 0.5 (p is 0, 1023:14).

The examiner notes that when p=0, the chemical formula $QR(L_{1-p}Z_p)$ reduces to QRL, wherein Q (Nb), R (Co) and L (Sn) are present in an atomic ratio of 1:1:1 (NbCoSn, 1023:14).

Regarding claims 6 and 9, the reference teaches that Q is niobium, R is cobalt and L is tin (NbCoSn, 1023:14 and Table 3).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. The factual inquiries set forth in *Graham* v. *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

6. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hohl et al. (J. Phys.: Condens. Matter, 10, 1998, pp. 7843-7850) as applied to claim 1 above.

Regarding claim 10, Applicant is directed to the paragraphs above for a discussion of Hohl et al. The reference discloses the claimed invention except that iridium is used as element R instead of cobalt (7845:28). The reference shows that iridium is an equivalent structure known in the art (R can be any cobalt group element, 7843:3-4). Therefore, because these two transition metals were art-recognized equivalents at the time the invention was made, one of ordinary skill in the art would have found it obvious to substitute cobalt for iridium.

7. Claims 12-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hohl et al. (J. Phys.: Condens. Matter, 10, 1998, pp. 7843-7850) as applied to claim 1 above and further in view of Chapman (US 3,648,469).

As to claims 12-13, Hohl et al. teach a thermoelectric conversion element comprising a p-type thermoelectric conversion material (abstract) and copper electrodes (7846:15), but is silent as to a first and second electrode connected to the p-type thermoelectric conversion material.

It is known in the art of thermoelectric conversion materials to have a first electrode (top thin metallic bar, #14, Fig. 2 and 2:20-24) and second electrode (bottom thin metallic bar, #14, Fig. 2 and 2:20-24) connected to the thermoelectric conversion material (thin metallic bars, #14, are connected to P-type, #12, and N-type, #13, semiconductor, Fig. 2 and 2:24-28), as taught by Chapman.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to include the electrodes of Chapman with the thermoelectric conversion element of Hohl et al., because doing so allows for electrical current to be conducted between adjacent semiconductor elements, as taught by Chapman (2:23-24), thus allowing for multiple elements to be connected together.

Regarding claim 14, Hohl et al. is silent to an insulator connected to at least one of the first electrode and second electrode.

It is known in the art of thermoelectric devices to have an insulator (thermal insulation, #18, Fig. 2 and 2:45) connected to at least one of the first electrode and second electrode (#18 is connected to electrodes, #14), as taught by Chapman.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to provide the insulator of Chapman in the thermoelectric device of Hohl et al. in view of Chapman et al., because doing so restricts undesirable heat transfer from the warm side to the cool side, as taught by Chapman (2:44-46).

Regarding claim 15, Hohl et al. teach p-type (NbIrSn, abstract) and n-type ($NbIrSn_{1-x}Sb_x$, 7848:13) thermoelectric conversion materials, but is silent as to the n-type thermoelectric conversion materials and the p-type thermoelectric conversion materials being alternately and electrically connected in series.

It is known in the art of thermoelectric devices to have the n-type thermoelectric conversion materials and the p-type thermoelectric conversion materials alternately and electrically connected in series as taught by Chapman (Fig. 2 and 2:17-18).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to have the n-type thermoelectric conversion materials and the p-type thermoelectric conversion materials of Hohl et al. alternately and electrically connected in series, because doing so allows for heat to be transferred in the thermoelectric device, as taught by Chapman (2:15-18), in order to cool or heat a particular side of the device as desired (1:52-58).

Regarding claim 16, Hohl et al. is silent as to a DC power supply and a load electrically connected to the thermoelectric conversion element operated by a current supplied from the thermoelectric conversion element.

It is known in the art to have a DC power supply (DC voltage and control, Fig. 2 and 1:63) electrically connected to the thermoelectric conversion element (via electrical conductors, #16 and 2:34)), as taught by Chapman.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to have a DC power supply electrically connected to the thermoelectric conversion element of Hohl et al. in view of Chapman et al., because doing so provides power to the thermoelectric device which in turn can heat or cool an object, such as a pillow, as desired by the user and shown by Chapman (1:63-70).

8. Claims 12 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hohl et al. (J. Phys.: Condens. Matter, 10, 1998, pp. 7843-7850) and further in view of Hanson (US 4,095,998).

As to claims 12 and 17, Hohl et al. is silent as to a first electrode and a second electrode connected to the thermoelectric conversion material and a load electrically connected to the thermoelectric conversion element and operated by a current supplied from the thermoelectric conversion element.

It is known in the art of thermoelectric devices to have an electric apparatus (thermoelectric voltage generator, title) comprising a first electrode (outer electrical contact, #17, Fig. 1 and 2:23-24) and a second electrode (inner electrical contact, #16, Fig. 1 and 2:21-22) connected to the thermoelectric conversion material (#16 and #17 are attached to N- and P-type semiconductors of #26, thermoelectric elements, Fig. 1 and 2:22-29) a load (device of vehicle, 3:36-37) electrically connected to the thermoelectric conversion element (3:36-37) and operated by a current supplied from the thermoelectric conversion element (3:35-38), as taught by Hanson.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use the thermoelectric device of Hohl et al. in the apparatus of Hanson et al.,

because doing so provides a way to harness the electricity generated from the thermoelectric device, such as to power a device in the vehicle, as taught by Hanson (3:35-38).

9. Claims 18-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hohl et al. (J. Phys.: Condens. Matter, 10, 1998, pp. 7843-7850) and further in view of Hanson (US 4,095,998).

Regarding claim 18, Hohl et al. teach a thermoelectric conversion material comprising:

- a half-Heusler alloy (half-filled Heusler, p. 7844, line 2) represented by the formula $QR(L_{1-p}Z_p)$, ($NbIrSn_{1-x}Sb_x$, 7845:28), where
- Q is at least one element selected from group 5 elements (Nb, 7845:28),
- R is at least one element selected from cobalt, rhodium, and iridium (Ir, 7845:28),
- L is at least one element selected from tin and germanium (Sn 7845:28),
- Z is at least one element selected from indium and antimony (Sb 7845:28), and
- p is a numerical value that is equal to or greater than 0 and less than 0.5 (p is 0.01 7845:28).

The examiner notes that when p=0, the chemical formula $QR(L_{1-p}Z_p)$ reduces to QRL. This corresponds to ABX of the reference, wherein Q (A, 7843:2-3), R (B, 7843:3-4) and L (X, 7843:4-5) are present in an atomic ratio of 1:1:1 (ABX, 7843:1).

The reference is silent as to an electric power generating method of using a thermoelectric conversion element comprising a thermoelectric conversion material and a first electrode and a second electrode connected to the thermoelectric conversion material, the method comprising: supplying heat so that a temperature difference is caused between the first electrode

and the second electrode so as to produce a potential difference between the first electrode and the second electrode.

It is known in the art of thermoelectric devices to have an electric power generating method of using a thermoelectric conversion element (#26, thermoelectric elements, Fig. 1 and 2:22-23) comprising a thermoelectric conversion material (N- and P-type semiconductors, Fig. 1 and 2:29) and a first electrode (outer electrical contact, #17, Fig. 1 and 2:23-24) and a second electrode (inner electrical contact, #16, Fig. 1 and 2:21-22) connected to the thermoelectric conversion material (3:36-37), the method comprising: supplying heat (high temperature gas, 1:54-55) so that a temperature difference is caused between the first electrode (cold thermojunction, #17a, of outer electrode (3:28-29) and the second electrode (hot thermojunction, #16a, of inner electrode, 3:27-28) so as to produce a potential difference between the first electrode and the second electrode (3:30-31).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use the thermoelectric device of Hohl et al. in the electric power generating method of Hanson, because doing so provides a way to harness the electricity generated from the thermoelectric device, such as to power a device in the vehicle, as taught by Hanson (3:35-38).

Regarding claims 19-21, Hohl et al. teach that p is 0.01 (x=0.01, 7845:28).

Regarding claim 22, Hohl et al. teach that Q is niobium (Nb, 7845:28).

Regarding claim 23, Hohl et al. teach that R is cobalt (A=Nb, 1st column, Table 2).

Regarding claim 24, Hohl et al. teach that L is tin (Sn, 7845:28).

Regarding claim 25, Hohl et al. teach that p is 0.01 (x=0.01, 7845:28) and Z is antimony (Sb 7845:28).

Regarding claim 26, Hohl et al. teach that Q is niobium (A=Nb, Table 2), R is cobalt (B=Co, Table 2) and L is tin (X=Sn, Table 2 and 7844:3).

Regarding claim 27, Applicant is directed to the paragraphs above for a discussion of Hohl et al. The reference discloses the claimed invention except that iridium is used as element R instead of cobalt (7845:28). The reference shows that iridium is an equivalent structure known in the art (R can be any cobalt group element, 7843:3-4). Therefore, because these two transition metals were art-recognized equivalents at the time the invention was made, one of ordinary skill in the art would have found it obvious to substitute cobalt for iridium.

Regarding claim 28, Hohl et al. teach that that the half-Heusler alloy is made of single phase (7846:34-36).

Regarding claims 29-30, Hohl et al. in view of Hanson teach that the first or second electrode is connected to the p-type thermoelectric conversion element and an insulator (Hanson: inner electrical contact, #16, is attached to both the inner electrical insulation, #20, and the P-type thermoelectric element, #26, Fig. 1 and 2:18-23).

10. Claims 31-43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hohl et al. (J. Phys.: Condens. Matter, 10, 1998, pp. 7843-7850) and further in view of Chapman (US 3,648,469).

As to claim 31, Hohl et al. teach a thermoelectric conversion material comprising:

- a half-Heusler alloy (half-filled Heusler, p. 7844, line 2) represented by the formula $QR(L_{1-p}Z_p)$, ($NbIrSn_{1-x}Sb_x$, 7845:28), where
- Q is at least one element selected from group 5 elements (Nb, 7845:28),
- R is at least one element selected from cobalt, rhodium, and iridium (Ir, 7845:28),

- L is at least one element selected from tin and germanium (Sn 7845:28),
- Z is at least one element selected from indium and antimony (Sb 7845:28), and
- p is a numerical value that is equal to or greater than 0 and less than 0.5 (p is 0.01 7845:28).

The examiner notes that when p=0, the chemical formula $QR(L_{1-p}Z_p)$ reduces to QRL. This corresponds to ABX of the reference, wherein Q (A, 7843:2-3), R (B, 7843:3-4) and L (X, 7843:4-5) are present in an atomic ratio of 1:1:1 (ABX, 7843:1).

The reference is silent as to a cooling method of using a thermoelectric conversion element comprising a thermoelectric conversion material and a first electrode and a second electrode connected to the thermoelectric conversion material, the method comprising: causing a potential difference between the first electrode and the second electrode so as to produce a temperature difference between the first electrode and the second electrode such that one of the first electrode and the second electrode is made a low temperature part.

It is known in the art of cooling methods for thermoelectric devices to use a thermoelectric conversion element (#10, thermoelectric pillow, Fig. 1,2 and 2:10) comprising a thermoelectric conversion material (P-type, #12, and N-type, #13, semiconductor material, Fig. 2 and 2:17-18) and a first electrode (top thin metallic bar, #14, Fig. 2 and 2:20-24) and a second electrode (bottom thin metallic bar, #14, Fig. 2 and 2:20-24) connected to the thermoelectric conversion material (thin metallic bars, #14, are connected to P-type, #12, and N-type, #13, semiconductor, Fig. 2 and 2:24-28), the method comprising: causing a potential difference between the first electrode and the second electrode so as to produce a temperature difference

between the first electrode and the second electrode (1:41-47) such that one of the first electrode and the second electrode is made a low temperature part (1:51), as taught Chapman.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use the thermoelectric device of Hohl et al. in the cooling method of Chapman, because doing so results in a device that can be heated or cooled as desired by the user, such as a dry, cool pillow that can be plugged into a standard electrical outlet and used to cool body fever, as taught by Chapman (1:25-28).

Regarding claims 32-34, Hohl et al. teach that p is 0.01 (x=0.01, 7845:28).

Regarding claim 35, Hohl et al. teach that Q is niobium (Nb, 7845:28).

Regarding claim 36, Hohl et al. teach that R is cobalt (A=Nb, 1st column, Table 2).

Regarding claim 37, Hohl et al. teach that L is tin (Sn, 7845:28).

Regarding claim 38, Hohl et al. teach that p is 0.01 (x=0.01, 7845:28) and Z is antimony (Sb 7845:28).

Regarding claim 39, Hohl et al. teach that Q is niobium (A=Nb, Table 2), R is cobalt (B=Co, Table 2) and L is tin (X=Sn, Table 2 and 7844:3).

Regarding claim 40, Applicant is directed to the paragraphs above for a discussion of Hohl et al. The reference discloses the claimed invention except that iridium is used as element R instead of cobalt (7845:28). The reference shows that iridium is an equivalent structure known in the art (R can be any cobalt group element, 7843:3-4). Therefore, because these two transition metals were art-recognized equivalents at the time the invention was made, one of ordinary skill in the art would have found it obvious to substitute cobalt for iridium.

Regarding claim 41, Hohl et al. teach that the half-Heusler alloy is made of single phase (7846:34-36).

Regarding claim 42, Hohl et al. teach a thermoelectric conversion element comprising a p-type thermoelectric conversion material (abstract) and copper electrodes (7846:15), but is silent as to a first and second electrode connected to the p-type thermoelectric conversion material.

It is known in the art of thermoelectric conversion materials to have a first electrode (top thin metallic bar, #14, Fig. 2 and 2:20-24) and second electrode (bottom thin metallic bar, #14, Fig. 2 and 2:20-24) connected to the thermoelectric conversion material (thin metallic bars, #14, are connected to P-type, #12, and N-type, #13, semiconductor, Fig. 2 and 2:24-28), as taught by Chapman.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to include the electrodes of Chapman with the thermoelectric conversion element of Hohl et al., because doing so allows for electrical current to be conducted between adjacent semiconductor elements, as taught by Chapman (2:23-24), thus allowing for multiple elements to be connected together.

Regarding claim 43, Hohl et al. is silent to an insulator connected to at least one of the first electrode and second electrode.

It is known in the art of thermoelectric devices to have an insulator (thermal insulation, #18, Fig. 2 and 2:45) connected to at least one of the first electrode and second electrode (#18 is connected to electrodes, #14), as taught by Chapman.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to provide the insulator of Chapman in the thermoelectric device of Hohl et al. in view of Chapman et al., because doing so restricts undesirable heat transfer from the warm side to the cool side, as taught by Chapman (2:44-46).

Response to Arguments

11. Applicant's arguments, see pages 2-7, filed 3 Apr 2008, with respect to the rejection(s) of claim(s)1-43 under 35 USC 102/103 have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of Hanson, Chapman, Hohl et al. and Tobola et al.

Correspondence/Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to TYLER N. BENNETT whose telephone number is (571)270-5260. The examiner can normally be reached on Mon-Thurs 0830-1800.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alexa Neckel can be reached on 571-272-1446. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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